PVC INSTALLATION MANUAL
Vision

To become preferred and most respected distributor and manufacturer of quality plastic pipe systems for the Infrastructure (Mining, Industrial, Irrigation and Civil) and Building markets in Sub-Saharan Africa.

Mission

To grow responsibly towards becoming a truly regional (sub-Saharan Africa) player represented in major centres, manufacturing fast moving product ranges at local plants across the region as well as providing a wholesale offering on group and externally produced products.

Values

- Integrity
- Honesty
- Passion
- Reliability
- Trust
- Accountability
- Compassion
- Professionalism
- Respect
- Commitment
- Excellence
- Ethics

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**Installation**

Please note:

- All work should be carried out in accordance with national building regulations and applicable bylaws
- Information in this guide is intended to highlight and supplement relevant sections of South African National Standards SANS 966 Parts 1 and 2, and SANS 1200

**Underground Installations**

**Trenches**

A specified grade and alignment for a trench is generally determined by the project engineer. In order to minimise risks associated with open trenches, it is important to note that the trench should not be opened too far in advance of the pipe laying operation.

**Width**

As a norm, a trench width should be kept to 300mm wider than the diameter of the pipe to allow space around the pipe for jointing and initial compaction. Trench widths should be kept as close to the minimum as possible.

**Depth**

Common practice stipulates a minimum cover of 900mm above the crown of the pipe, which is determined by the following factors:

- Loads imposed on the pipe by mass of backfill material
- Degree of compaction of backfill
- Expected traffic loads
- Possibility of future excavations in the vicinity of the pipeline

The actual trench depth allows for the specified minimum cover, the pipe diameter and the specified minimum bedding depth (100mm)

**Bedding**

The bed of the trench must be inspected and cleared of any hard or sharp projections which may cause damage to the pipe. The bedding should be carefully and uniformly compacted and levelled with suitable material. Granular materials are preferred as they contain little or no fines and require minimal compaction.

The majority of particles in the bedding material should be no more than 20mm; however, it is permissible for a small percentage of particles to exceed this amount up to 40mm.

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**Laying of pipes**

Prior to installation, pipes should be thoroughly checked for possible defects or damage.

Including:

- Damage to surfaces (internal and external) should be limited to superficial scratches which do not exceed 5% of the standard wall thickness.

- Spigot or socket ends must be cleared of dirt and burrs

- The chamfer on the spigot end must be uniform, approximately 15° right around the circumference of the pipe

The pipeline must be laid directly onto the prepared bedding.

**Deflection & bending**

A misalignment of 0.5° can be accommodated for every rubber ring joint used and a length of pipe can be purposefully and uniformly bent to a limited extent (the radius of the bend should be no less than 300 times the pipe diameter).

**Backfilling**

**Material**

The same material used for the bedding should form the sidefilling and initial backfilling (overlay) and should be compacted to 300mm above the crown of the pipe. For the rest of the backfilling, excavated material from the site can be used, unless otherwise specified by the engineer.

**Contraction**

Often, pipes may have been in the sun prior to installation and may have expanded. Each pipe must be partially backfilled immediately after installation in order to restrict the possible subsequent contraction of each pipe length, where it is then catered for by the rubber ring joint system.

**Side Filling & Overlay**

Suitable material is carefully and evenly placed in un-compacted layers of about 75mm and tamped by hand until it is level with the crown of the pipe. To restrict pipe movement, simultaneously fill and compact material evenly on either side of the pipe. Further 150mm un-compacted layers are placed and hand tamped until a level of 300mm above the crown is reached.

**Main Backfill**

The remainder of the trench is filled in layers of 300mm and can be compacted by means of mechanical equipment if desired. All joints must be left exposed until pressure testing has been completed. Thereafter, the same backfilling process can be followed at the joints.

**Anchoring**

Concrete thrust blocks are necessary for buried PVC pressure pipe installations with rubber ring joints in order to anchor the pipeline and avoid possible failure when pressure is applied.

The purpose of a thrust block is to spread the load of a pressurised pipe over a larger bearing area and against the undisturbed surface of the trench side wall. The size of the thrust block is designed bearing in mind:

- Changes of direction greater than 10° (e.g. Tees and Bends)
- Changes in pipe size
- Valves and end caps

Engineers will take into consideration the load bearing capacity of the soil, the test pressure and the direction of the resultant thrust when calculating the sizes and positions of thrust blocks.

**Note:** Temporary thrust blocks can be constructed at the two ends of a test section and removed after testing is complete.

**Test Length**

Pipelines less than 1000m long can be tested as a whole. For longer pipelines, it is advisable to divide testing into sections with the first test section about 500m and thereafter no more than 1000m. This will allow for the quicker identification of faulty installation and/or handling.
Concrete Casting

The following precautions must be observed when casting PVC pipes in concrete:

- The pipe must be completely wrapped in a compressible material (such as rubber insertion) with a thickness of 5% of the diameter of the pipe before being cast into the concrete.
- Alternatively, a flexible joint such as a rubber ring joint can be used at the entry and exit point of the concrete.
- If an expansion joint is incorporated into the concrete, then a coinciding rubber ring joint must also be incorporated into the pipeline.

Testing

Marley PVC pressure pipes are SABS approved and are therefore subjected to the relevant quality tests as specified by SANS 966 Part 1 and 2 prior to dispatch. The purpose of field testing is therefore to check the design of the pipeline and the quality of workmanship applied during construction.

Pressure Test

Pressure testing occurs after the completion of the bedding and backfilling process. At this stage, all joints should still be exposed to allow for inspection. Thrust blocks for fittings and valves must be set and cured. Any temporary thrust blocks must be adequately secured and supported in order to handle the thrust of the pressure test.

Applying Pressure

Allow the pipeline to stand for 12 hours after it has been filled before commencing the pressure test to allow any remaining air to reach the highest point and be bled off.

It is recommended that pressure is applied for 1 hour at a pressure not exceeding 1.25 times the pressure of the class of pipe being tested. Where it is specified that pressure be carried out at 1.5 times, it is recommended that it be 1.5 times the design working pressure of the pipeline as opposed to 1.5 times the class of the pipe.

Pressure readings must be taken from the lowest point of the test section. Once the test pressure is reached, any drop in pressure must be recorded every 15 minutes. Thereafter pressure is restored to record the quantity of water required to make up the pressure.

The rate of pressure drop should decrease between readings; failure to do so could indicate a leakage. If no leaks are found after inspecting the line, then the problem could be as a result of entrapped air. In this case, let water flow through the line to move the air to the air valve points.

Table 1: Recommended filling rate

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Max. filling rate (ℓ/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>5</td>
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<tr>
<td>63</td>
<td>8</td>
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<tr>
<td>500</td>
<td>550</td>
</tr>
</tbody>
</table>

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Leakage Rates

The causes of pressure drops during testing include leaking joints or valve glands, pipe expansion, air going into solution, or thrust block movement. These causes should diminish and therefore there is a limit to the amount of make-up water allowed to restore pressure.

A successful test is achieved when the quantity of make-up water required does not exceed the litres calculated by the following formula as specified by SANS 1200 L clause 73.3(b) recommendation DP 4191:

\[
0.01 \times \text{diameter of pipe (mm)} \\
\times \text{length of test section (km)} \\
\times \text{square root of the test pressure (mPa)}
\]

Example:
For a 200mm Class 16 pipeline 1500m in length with a test pressure of 20 bar, the allowable amount of water required to restore the test pressure after 1 hour can be calculated as follows:

\[
0.01 \times 200 \times 1.5 \times \sqrt{20} = 4.24 \text{ litres}
\]

Table 2: Allowable Leakage Rates
(litres/kilometre/hour at a test pressure of 1.25 times pipe class)

<table>
<thead>
<tr>
<th>Pipe Diameter (mm)</th>
<th>Test Pressure 750 kPa (Class 6)</th>
<th>Test Pressure 1125 kPa (Class 9)</th>
<th>Test Pressure 1500 kPa (Class 12)</th>
<th>Test Pressure 2000 kPa (Class 16)</th>
<th>Test Pressure 2500 kPa (Class 20)</th>
<th>Test Pressure 3125 kPa (Class 25)</th>
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</thead>
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<tr>
<td>50</td>
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<td>0.53</td>
<td>0.61</td>
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<td>1.77</td>
<td>1.98</td>
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<td>1.48</td>
<td>1.71</td>
<td>1.98</td>
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<td>1.96</td>
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<td>2.53</td>
<td>2.83</td>
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<td>2.83</td>
<td>3.16</td>
<td>3.54</td>
</tr>
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<td>3.95</td>
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<td>5.66</td>
<td>6.32</td>
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<td>4.77</td>
<td>5.51</td>
<td>6.36</td>
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<tr>
<td>500</td>
<td>4.33</td>
<td>5.33</td>
<td>6.12</td>
<td>7.07</td>
<td>7.91</td>
<td>8.84</td>
</tr>
</tbody>
</table>

After testing, all exposed joints must be backfilled in the same manner used for the rest of the trench.

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**Entrapped Air**

The effects of entrapped air in a pressurised pipeline and inadequate vacuum relief can be very detrimental as well as costly. Care must be taken to ensure that adequate escape routes are put in place, especially in the case of pipes laid along a very flat terrain.

It is therefore very important to follow best practise procedure as specified by either the design engineer or the manufacturer’s guidelines.

**Air Testing**

The purpose of an air test (manometer test) is to ensure that newly laid sewer lines do not leak contaminated water into the surrounding soil and is recommended in SABS 0252-2.

In order to carry out the test, the following equipment is needed:

- A manometer with air pump and connecting hoses
- Test plugs and end caps
- Soapy water (or smoke-producing equipment)

### Procedure

1. Fill all traps in the test section with water
2. Fit test plugs to open ended pipes and fittings
3. Make sure that access covers are secured
4. Fit the manometer to a test plug and adjust the water level to zero
5. Pump air into the system until the manometer gives a pressure reading of about 350mm water
6. Close the manometer valve and let the water level stabilise for a couple of minutes
7. Ensure that no leaks are present in the testing equipment
8. Adjust the pressure to 250mm water
9. Start recording the time.

Pressure can drop to no less than 125mm water within a minimum period of time. This time varies depending on the size of the line being tested.

### Table 3: Minimum time for pressure drop to 125mm water

<table>
<thead>
<tr>
<th>Pipe Size (mm)</th>
<th>Min. amount of time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>160</td>
<td>3</td>
</tr>
<tr>
<td>200</td>
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<td>250</td>
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<tr>
<td>450</td>
<td>9</td>
</tr>
<tr>
<td>500</td>
<td>10</td>
</tr>
</tbody>
</table>

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**Above Ground Installations**

In above ground installations, care must be taken when installing pipelines in a specific area, avoiding high-temperature areas and direct contact with continually vibrating equipment. Vibrations should be minimised utilising a suitable flexible coupling.

**Support**

Wherever possible, pipes must be supported by broad, smooth, bearing surfaces in order to minimise physical damages and stress concentration, and prevent sagging or distortion along the pipeline. Continuous support must be provided around at least 120° of the circumference of the pipe.

Brackets or straps should be no less than 25mm wide and must not be over-tightened as this may distort the pipe. Flexible material such as a rubber insertion can be used between the pipe and the bracket or strap. Supports must be positioned carefully so that they can restrain and support the pipeline as well as allow for expansion or contraction that will not induce bending moments at fixed points.

Types of supports:
- Free support: provides support while allowing the pipe to move freely along its axis
- Swinging support: keeps the pipe suspended while allowing free movement in two directions
- Fixed support: restricts movement in at least two planes – used to contain movement and thrust

Spacing is dependent on factors such as pipe diameter, maximum operating pressure and the density of the fluid being conveyed. Best practice stipulates that spacing should be reduced by 25% for every 10°C of operating temperature above 20°C. Continuous support is required at 60°C.

**Table 4: Guide for maximum spacing when 20°C water is conveyed**

<table>
<thead>
<tr>
<th>Pipe diameter (mm)</th>
<th>Max spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.1</td>
</tr>
<tr>
<td>65</td>
<td>1.2</td>
</tr>
<tr>
<td>75</td>
<td>1.3</td>
</tr>
<tr>
<td>90</td>
<td>1.4</td>
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<td>450</td>
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<tr>
<td>500</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Expansion and contraction**

Coefficient of thermal expansion:

$8 \times 10^{-5}$

i.e. expansion of 0.08mm per metre per °C rise in temperature

Example:
A 30°C rise in temperature will cause a 14.4mm expansion on a 6m pipe

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**Materials Handling & Storage**

**Transport**

- Pipes should be transported by a suitable vehicle with a flat and level load bed and no sharp objects or projections.
- The uprights on a vehicle must be at least 100mm wide.
- Pipes should have continuous contact, over their entire length with the load bed.
- For mixed loads, the heaviest/largest pipes should be loaded first followed by lighter/smaller pipes.
- During transport, all loads should be securely anchored to prevent movement and chaffing of the pipe.

**Handling & Storage**

While PVC pipes are light and easy to handle, they should under no circumstances be maltreated and care should be taken to avoid damage.

Recommended storage measures to prevent damage to PVC pipes:

- Pipes should be stored on level ground which is free from sharp objects and dry grass or any materials which may constitute a fire hazard.
- Store away from exposure to excessive heat.
- Store in cool, dry conditions preferably under cover to avoid long term exposure to sunlight/UV light which may cause discolouration.

**Jointing**

**Cutting**

PVC pipes can easily be cut with a variety of hand or power tools. Be sure to remove burrs from the pipe after cutting.

**Rubber Ring Joints**

The Wavisafe Z-Lok joint is integrally moulded on one end of the pipe. The joint incorporates a factory fitted rubber sealing ring which is retained in position by a polypropylene lock ring. The opposite (spigot) end of the pipe is chamfered and has a “depth of entry” mark near the end. Each joint is capable of handling some expansion and contraction as well as angular deflection. The seal ring is designed to provide a watertight joint at high and low pressures.

**Chamfering**

Proper chamfering is important to facilitate the easy insertion of the spigot end into a socket without damaging or dislodging the rubber ring. Pipes that have had the chamfer cut off can easily be re-chamfered with a file. The chamfer should have an angle of 12 - 15° and about half of the normal wall thickness should be removed. The length of the resulting chamfer should be according to the dimensions in the table above.

**Table 5: Depth of Entry**

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Depth of Entry (mm)</th>
<th>Approx. Length of Chamfer (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>88</td>
<td>5</td>
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<tr>
<td>63</td>
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<tr>
<td>500</td>
<td>235</td>
<td>30</td>
</tr>
</tbody>
</table>

**Depth of Entry**

The “depth of entry” mark on the spigot end is a guide to correct depth of insertion of the spigot into the socket of the next pipe.

When pipes are cut on site, it is necessary to re-mark the “depth of entry” according to the dimensions in the following table:

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**Lubricant**

A lubricant will considerably reduce the effort required to make a joint AND will minimise the possibility of dislodging the rubber ring. The lubricant used should be water soluble, non-toxic and preferably of a gel consistency. The following alternative lubricants should NOT be used: Oil, grease, diesel, dishwashing liquid, etc.

**A** Check the spigot end of the pipe for correct chamfering as described above. Ensure that a “depth of entry” mark is visible and that no burns or damage is present.

**B** Wipe the spigot end clean.

**C** Check the socket end to ensure that the rubber ring is present and correctly fitted. Remove any dirt or mud that may be present.

**D** Apply a thin film of lubricant evenly around the spigot end to about half the distance to the depth of entry mark.

**E** Lubricate the rubber ring lightly.

**F** Place the spigot end of the pipe into the socket so that it rests against the rubber ring.

**G** Align the two pipes both horizontally and vertically to be sure that the rubber ring will not be dislodged.

**H** Push the spigot into the socket until the “depth of entry” mark is just visible at the edge of the socket. If undue force is necessary, it is advisable to start the process again.

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**Solvent Weld Joints**

Solvent cement jointing is a welding process and not a glueing process. If done correctly, separation will not be possible after the curing period. Jointing of pressure pipe should not be carried out on pipes and/or fittings if there is a rattle fit between dry pipes and/or fittings. There should be an interference fit between the components before solvent cement is applied. There are different solvents cements available for pressure applications and for non-pressure applications. Be sure to use the correct cement and that it has not “dried out” prior to use.

**Jointing procedure**

Assemble the required pipes, fittings and equipment as indicated below. Where possible, choose a site that is ventilated, under shade and away from wind.

A. Ensure that the spigot has been cut square and all burrs have been removed.

B. Mark the spigot at a distance equal to the internal depth of the socket.

C. Check that there is an interference fit between the dry spigot and socket before the spigot reaches the full depth indicated by the mark b) above.

D. Ensure that both components are dry (not illustrated).

E. Clean and degrease both components with an appropriate etch cleaner (not illustrated).

F. Using an appropriate brush, apply a thin film of solvent cement to the internal surface of the socket first. Then repeat this process on the spigot up to the mark made in b) above. The width of the brush should be such that solvent can be applied to both surfaces within about 30 seconds. DO NOT USE EXCESS SOLVENT CEMENT.

G. Make the joint immediately. Rotate the two components during insertion which should continue up to the mark made in b) above. If necessary, hold still for about 30 seconds.

H. Thereafter carefully wipe away any bead of excess solvent cement.

I. Do not disturb for at least 5 minutes (not illustrated).

J. Do not apply pressure for at least 24 hours.
HEAD OFFICE
Including Building Division

Tel: +27 (0)11 739-8600
Fax: +27 (0)11 739-8680

1 Bickley Road, Pretoriusstad, Nigel
P.O. Box 67, Nigel, 1490

GPS co-ordinates
S 26° 25’ 30,0”
E 28° 26’ 29,4”

INFRARED STRUCTURE DIVISION
Including Exports

Tel: 0861-MARLEY
Fax: +27 (0)11 314-9022

3 Platinum Close, Tsessebe Crescent
Midrand, Johannesburg

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PLEASE CONTACT A BRANCH OFFICE FOR YOUR NEAREST MARLEY STOCKISTS.

Bloemfontein +27 (0)51 434-2331/5
Cape Town +27 (0)21 980-8460
Durban +27 (0)31 791-5800
East London +27 (0)43 726-6505
Port Elizabeth +27 (0)41 484-7744
George +27 (0)44 871 4889
Nelspruit +27 (0)13 753-2571
Polokwane +27 (0)15 292-4141
Klerksdorp +27 (0)18 462-2655

Marley (Namibia) (Pty) Ltd. (00264) 61-237201
Contract Supplies (Botswana) (00267) 392-2922